EXCRETION OF CATECHOLAMINES BY THE GASTRIC MUCOUS MEMBRANE

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It is concluded from the results obtained that in physiological conditions the mucous membrane of the stomach excretes catecholamines. Noradrenalin is predominant in the secretion of the greater curvature, adrenalin in that of the lesser curvature.

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The least investigated aspect of the physiology of the stomach is the excretory activity of its mucous membrane. Investigations have been published [5, 6] giving the first information on the content of organic substances, especially proteins, in the gastric juice. By now a number of physiologically active macromolecular components of the gastric secretion have been discovered and studied [7, 11, 12]. From the standpoint of the relationship between local and central mechanisms of regulation of gastric function, the presence of acetylcholine in the gastric juice [2, 9] and its quantitative changes in the secretion and wall of the stomach under the influence of ganglion-blocking substances [1, 3, 4] are of definite importance. Histamine liberation by the mucous membrane likewise is evidently largely under the control of mediators of nervous excitation. From data in the literature, S. A. Mirzoyan concluded that the neuro-humoral mechanisms of regulation of gastric activity may also act as triggers for the production of other physiologically active substances, especially catecholamines, by the gastric mucosa. This hypothesis was also based on the results of analyses [10] of the action of acetylcholine on the vessels of the rabbit's ear, demonstrating its dual effect: dilatation in control experiments and constriction after atropine administration. Moreover, the vasoconstrictor action of acetylcholine is due to the liberation of noradrenalin.

In the present investigation the excretory activity of the gastric mucosa was studied during gastric digestion. The results described below, concerning excretion of the mediators of excitation of adrenergic structures, may provide useful information for evaluation of some physiological events.

The objects of the investigation were to determine the presence of adrenalin and noradrenalin in gastric juice obtained in response to a food stimulus (meat) administered to dogs with a Pavlov pouch, to determine the relative concentrations of catecholamines in the juice secreted in response to meat from pouches fashioned from the lesser and greater curvatures, and to study the dynamics of catecholamine excretion in in response to administration of exogenous adrenalin and noradrenalin.

EXPERIMENTAL METHOD

Experiments were carried out on 4 dogs with isolated gastric pouches formed from the lesser and greater curvatures. Usually the investigations began 18-20 h after the last meal. Raw meat (200 g) was used as stimulus. The juice was collected over a period of 3 h. The proteins in the gastric juice were precipitated with perchloric acid. After filtration and centrifugation, the supernatant was allowed to stand overnight in a refrigerator at −19°. Next day the concentration of catecholamines was determined spectrofluorometrically [8].

EXPERIMENTAL RESULTS

The results show that catecholamines were present in the 3 hourly portions of gastric juice obtained from the four dogs tested (Duglas, Dunai, Lev, and Tigr). The experimental results, whether for the total

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catecholamine concentration or for the relative adrenalin and noradrenalin concentrations in eluates of the secretion obtained from pouches from the lesser and greater curvatures, were noticeably dissimilar.

Secretion of the fundal glands contained much more total catecholamines than juice from the lesser curvature (see Table 1). The results of quantitative determination of adrenalin and noradrenalin show that in most cases the secretion from the fundal glands contained noradrenalin, whereas the juice from the glands of the lesser curvature contained appreciably more adrenalin than noradrenalin.

The excretory topography of the stomach concerning the excretion of catecholamines as a whole and of their individual components thus varied. The total catecholamine content in the secretion of glands from the fundus in dogs Duglas, Dunai, and Tigr was thus 3-4 times greater than in juice obtained from the lesser curvature. In the dog Lev it was only twice as great. It was noted that although the pouch from the lesser curvature of the experimental animals secreted much more juice, the absolute content of catecholamines remained low. A more detailed analysis shows that the 3-hourly secretion of the lesser curvature glands of the dog Duglas amounted 41.7 ± 1.37 ml, while secretion from the greater curvature was 22.08 ± 0.29 ml. The corresponding figures for Dunai were 47.56 ± 1.22 and 28.11 ± 0.71 ml, for Lev 42.65 ± 1.01 and 17.13 ± 0.88 ml, and for Tigr 41.84 ± 1.24 and 15.28 ± 0.68 ml.

TABLE 1. Concentration of Noradrenalin (NA), Adrenalin (A), and Total Catecholamines (CA) in Gastric Juice from Lesser and Greater Curvatures of Experimental Dogs (in μg/ml)

Name of experimental dog	Lesser curvature			Greater curvature		
	NA	A	CA	NA	A	CA
Duglas	1,116±0,25 (13)	0,895±0,13 (13)	2,011±0,222 (13)	8,60±1,54 (15)	0,209±0,064 (15)	8,809±1,501 (15)
Dunai	1,29±0,075 (7)	1,58±0,15 (7)	2,87±0,294 (7)	8,88±1,89 (8)	0,27±0,176 (8)	9,14±1,68 (8)
Lev	0,30±0,09 (11)	1,34±0,4 (11)	1,64±0,223 (11)	2,89±0,214 (11)	0,76±0,14 (11)	3,66±0,199 (11)
Tigr	0,05±0,044 (10)	1,84±0,443 (10)	1,89±0,335 (10)	6,02±1,52 (12)	0,88±0,332 (12)	6,9±1,34 (12)

Note. The figures are mean values obtained from the number of experiments shown in parentheses.

The volume of juice obtained in 3 h from the greater curvature pouch was only half that obtained from the glands of the lesser curvature, but the content of catecholamines excreted by the greater curvature was more than four times greater than their content excreted by the lesser curvature. This suggests that local mechanisms regulate catecholamine excretion by the gastric mucous membrane.

In face of these results, we studied the excretory power of the stomach during administration of exogenous catecholamines, and determined the changes in the relative concentrations of adrenalin and noradrenalin in juice from the lesser and greater curvatures. In experiments to study secretion obtained in the dog Duglas in response to a food stimulus, subcutaneous injection of adrenalin hydrochloride in a dose of 0.02-0.05 mg/kg for 4 days depressed juice secretion, and noradrenalin disappeared completely from the secretion of the gastric glands of the lesser curvature. The adrenalin concentration increased on the 1st and 2nd days. The total catecholamine content was increased on account of adrenalin. Conversely, in juice obtained from the greater curvature, the noradrenalin content rose from 8.6 ± 1.54 to 10.30 μg/ml. The adrenalin content rose particularly sharply on the first days. The total catecholamine content rose to a maximum on the 1st day, after which it fell.

After administration of crystalline noradrenalin in a dose of 0.02 mg/kg body weight none could be found in the secretion from the lesser curvature glands, whereas 1.116 ± 0.25 μg/ml was found in the control sample. The adrenalin content rose sharply from 0.895 ± 0.13 μg/ml to 2.2 μg/ml. The total catecholamine content increased correspondingly. The noradrenalin content fell gradually, and none was present on the 3rd day.

It may thus be concluded from these results that in physiological conditions catecholamines are excreted by the gastric mucous membrane, in different amounts from different parts of the stomach. Juice from the greater curvature contains more noradrenalin and juice from the lesser curvature, more adrenalin.

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